

Memorandum

To: Tamara Twardowski, Collegeville Borough

From: Mark Hood, P.E., LTAP

Date: February 26, 2021

Subject: Traffic Calming, Collegeville Borough, Montgomery County

BACKGROUND

In response to a technical assistance request from Collegeville Borough, LTAP conducted a field review of East 9th Avenue, Clayhor Avenue, and Park Avenue on February 16 with Tamara Twardowski and Craig Farr of Collegeville Borough. The Borough is concerned about the speed of motorists traveling along these roadways and was investigating traffic calming options to help with the situation. Refer to Figure 1.

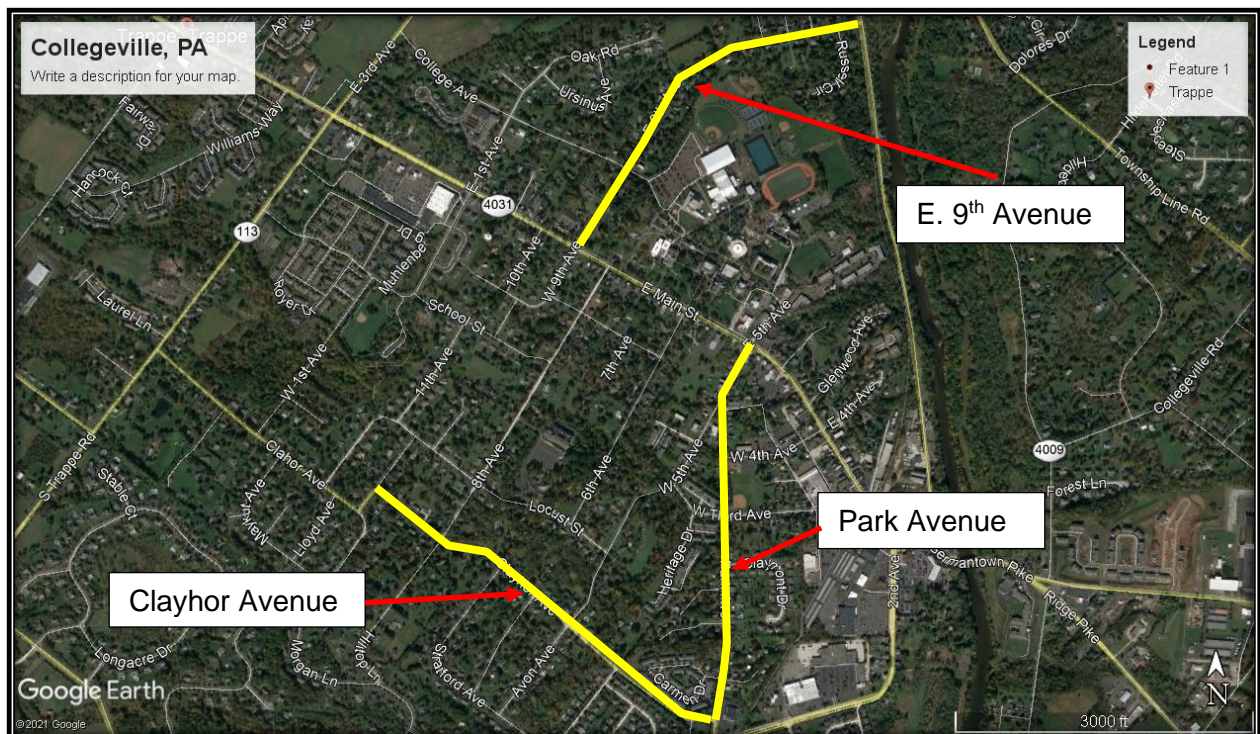


Figure 1: Collegeville Borough

Resources

Before discussing traffic calming concepts for these roads, note that field observations, discussions with municipal personnel, and traffic engineering experience are largely

responsible for the content and findings of this memo. In addition, specific references that were consulted include:

- 2009 Current Edition of the Manual on Uniform Traffic Control Devices (MUTCD)
- PennDOT Publications 46, 111, 212, 236, and 383
- ITE Traffic Calming State of the Practice
- PA Vehicle Code, Title 75
- PA Code, Title 67
- FHWA Speed Management and Traffic Calming websites
- For more information on traffic calming:
 - <https://www.youtube.com/watch?v=bkz026kKpRU>
 - <http://www.seattle.gov/transportation/trafficcircles.htm>
 - <http://www.philadelphiastreet.com/traffic-and-lighting/traffic-calming-policy-information/>
 - https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Pennsylvania LTAP is willing to clarify and provide additional information relating to any of the potential solutions listed.

TRAFFIC CALMING

PennDOT Publication 383, *Pennsylvania's Traffic Calming Handbook*, identifies specific traffic calming measures that are approved for use in PA and contains background information, definitions, standards, and other information on traffic calming. Pub 383 defines traffic calming as:

Traffic Calming	<p>The combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior, and improve conditions for non-motorized street users.</p>
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Traffic calming offers additional ideas to municipalities beyond traditional traffic engineering and enforcement resources to improve the livability and safety of a street. Pub 383 states that traffic calming is an option for consideration to alleviate certain traffic problems including speeding and cut-through traffic. There are no laws or PennDOT regulations that require the application of traffic calming. Thus, the Borough is under no obligation to install traffic calming but can consider it in certain selected situations. For a discussion on the Borough's authority to install traffic calming devices, refer to Pub 383 Chapter 3, Legal Issues, Page 9.

If the Borough chooses to implement traffic calming, they are required to conform to Pub 383 as per Title 67, Chapter 212, Section 212.9, Traffic Calming.

Traffic Calming Policy

Before installing any traffic calming devices, municipalities should have a traffic calming policy in place. Pub 383 identifies a process for developing the policy and recommends

an educational/outreach effort to inform residents about traffic calming, the benefits and costs, the negatives effects, and a rationale for prioritizing which streets are candidates for traffic calming. Another important step in the process once a policy has been established, will be acquiring residents' approval for the implementation. Typical policies require from 50% to 70% approval (the Borough can set its own threshold in its traffic calming policy). Pub 383 provides additional information on the recommended approach to traffic calming. **Note that the process described in Pub 383 is overly comprehensive for Collegeville Borough. The Borough should streamline the process to make it more manageable given their size and population.**

For the purpose of the issues in Collegeville Borough, LTAP will present an approach and discussion of what traffic calming features would be appropriate. **This memo is not intended to take place of a traffic calming policy or the engineering and traffic studies required for traffic calming, but to provide an example discussion of the approach to traffic calming.** The steps for this approach should include:

- Clearly defining the problem
- Identifying appropriate traffic calming features to address the problem
- Identifying design issues related to implementation
- Identifying positive and negative impacts
- Estimating costs
- Selecting traffic calming features to implement

Defining the Problem

There are several typical issues that traffic calming can address such as speeding, inappropriate volumes of traffic, and cut-through traffic on streets. The reduction of speeds and volumes can be a direct result of traffic calming which typically creates a safer, more livable street environment.

Pub 383 defines a speeding problem as 85th percentile speeds that are more than 10 MPH over the posted speed limit. This threshold may be a bit high and the Borough can and should set its own threshold in its traffic calming policy. Once speed and volume data are collected, and 85th percentile speeds are determined, the Borough can set a reasonable threshold in its traffic calming policy, such as 5-7 MPH over the posted speed limit, and determine whether the study roadways would have a defined speeding issue.

- **Speeding:** When speeding is the primary concern, the 85th percentile speed should exceed 10 mph over the posted speed limit before traffic calming is considered.

 - **85th percentile speed.** (The 85th percentile speed is the speed at or below which 85 percent of the motorists on a street are traveling. This speed is often used as a measure of the upper limit of reasonable speeds for prevailing conditions.)

Pub 383 also has a sample project ranking chart that the Borough can use to prioritize problem areas, and if there are problems on multiple streets, which streets should be a higher priority. The Project Ranking System is included in Chapter 4 of Publication 383 and shown below in Figure 2.

FIGURE 1 PROJECT RANKING SYSTEM

Criteria	Points	Basis for Point Assignment
Speed	0 to 30	Extent by which 85 percentile speeds exceed posted speed limit; 2 points assigned for every 1 mph.
Volume	0 to 25	Average daily traffic volumes (1 point assigned for every 120 vehicles).
Crashes	0 to 10	1 point for every crash reported within past 3 years.
Elementary or Middle Schools	0 to 10	5 points assigned for each school crossing on the project street.
Pedestrian Generators	0 to 15	5 points assigned for each public facility (such as parks, community centers, and high schools) or commercial use that generates a significant number of pedestrians.
Pedestrian Facility	0 to 10	5 points assigned if there is no continuous sidewalk on one side of the street; 10 points if missing on both sides.
Total Points Possible	100	

Figure 2: Sample Project Ranking System from Publication 383

Once speed and volume data are collected, and a traffic calming policy is in place, a more detailed traffic calming study can be completed to determine whether the speeds and volumes on E. 9th Avenue, Clayhor Avenue, and Park Avenue affect safety and/or affects the character/quality of life on the streets. Appropriate devices can also be determined based on specific conditions on each roadway.

Traffic Calming Options

Figure 3 below lists commonly used traffic calming measures that are approved for use in Pennsylvania in Pub 383. Studies show that each of these traffic calming measures have benefits—such as reducing the speed of traffic. Conversely, each traffic calming device will also have some negative effects. Pub 383 identifies the advantages and disadvantages for each of the treatments.

COMMONLY USED TRAFFIC CALMING MEASURES	
Horizontal Deflection	
Curb extension / bulb-out	Areas of expanded curbing that extend across a parking lane and may narrow a travel lane.
Chicane	Series of 3 bulb-outs, staggered at mid-block locations on alternating sides of the street.
Gateway	Entrance treatment, typically using physical and textural changes, that provides identity to an area.
On-street parking	Provision of on-street parking that reduces roadway width.
Raised median island / pedestrian refuge	Narrow islands, at mid-block or intersections, between travel lanes with breaks in landscaping and curbing for pedestrians.
Traffic circle	Raised island in the center of an intersection that requires vehicles to travel counterclockwise around the circle.
Vertical Deflection	
Speed hump	Raised humps in the roadway, typically 3 inches high with a 12 or 22-foot travel length.
Speed Cushion	Series of three to four cushions spaced across the roadway width that permits wide axle emergency vehicles to pass without slowing down.
Raised crosswalk	Marked pedestrian crossings elevated 3 to 6 inches above street grade at intersections or mid-block.
Raised intersection	Intersections, including crosswalks, raised 3 to 6 inches above street grade.
Physical Obstruction	
Semi-diverter	Directional closure created by physically blocking half the street.
Diagonal diverter	Physical barrier placed diagonally across a four-way intersection to create two unconnected intersections.
Right-in / right-out island	The use of raised islands to prevent left turns and through movements, to and from side streets, at intersections with major streets.
Raised median through intersection	Median barrier through an intersection that discourages through traffic in a residential area by restricting movements.
Street closure	The use of a cul-de-sac to close a roadway by extending a physical barrier across the entire width, obstructing all traffic movements.

Figure 3: Publication 383 Commonly Used Traffic Calming Measures

Several options that are appropriate to address a speeding issue include:

- Curb Extensions
- On-Street Parking
- Sidewalks
- Traffic Circles
- Speed Humps and Tables
- Speed Cushions
- Raised Intersections
- Raised Crosswalks

Each of these options have identified benefits, costs, and associated impacts, which are identified in Pub 383. An example of the benefits, costs, and impacts for a traffic circle is shown in Figure 4.

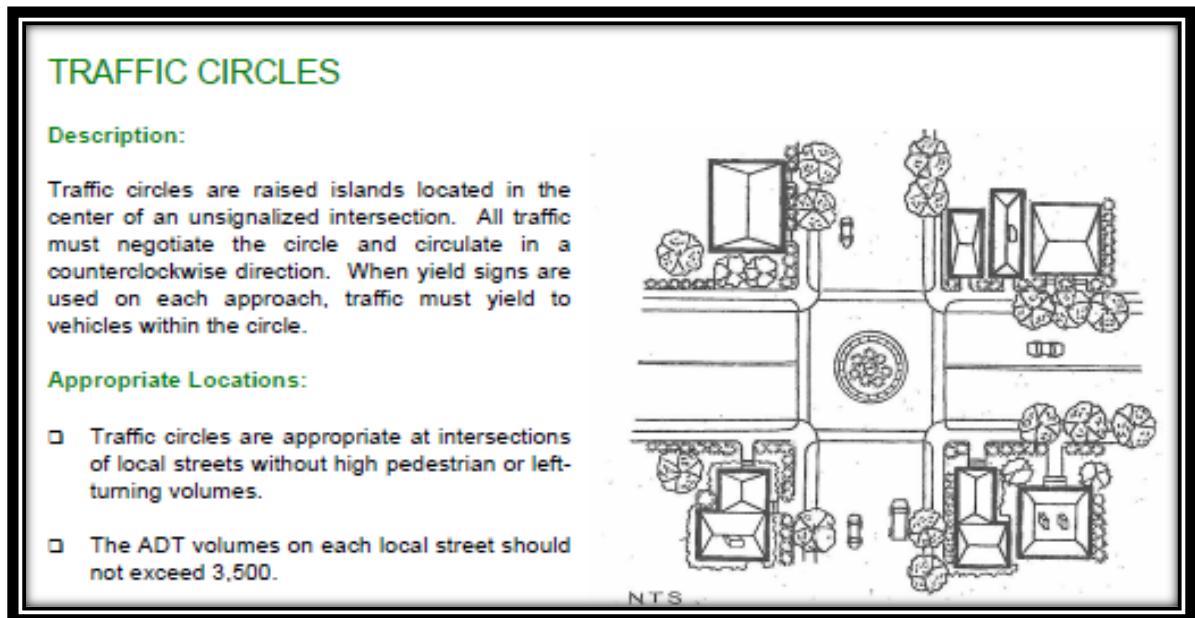


Figure 4: Traffic Circle Information from Pub 383

Implementation Considerations

Traffic calming features have many benefits, but also have design considerations and impacts that should be considered by the Borough. Design issues and impacts could include:

- the constructability of the traffic calming feature,
- the impact to residents traversing the traffic calming features,
- the impact on roadway drainage, cross slopes, and pavement,

- the impact on services such as snow removal, trash collection, transit, school buses, and street sweeping,
- the diversion of traffic and what streets the issue may shift to,
- the effect on emergency vehicle response time, and
- the construction cost/maintenance costs.

For a full discussion of these impacts, including costs of different devices, refer to Pub 383.

One method to reduce the unknowns associated with the implementation of traffic calming is to use temporary installations. There are a variety of physical temporary traffic calming devices, including speed cushions. Other traffic calming features can be implemented in a temporary manner using paint and traffic control devices such as delineators or cones and barrels. Figure 5 shows a temporary speed hump that was installed in East Bradford Borough, Chester County.



Figure 5: Example of a Temporary Speed Hump

PARK AVENUE

Park Avenue runs from the traffic signal at E. Main Street (SR 4031) to the traffic signal at Second Avenue (SR 0029) and is 0.80 miles long according to PennDOT's Type 5 Map. It is a paved two-way, two-lane Borough road (state turnback road) that is currently posted at 25 MPH. It has curbing on both sides and continuous sidewalk on the west side of the roadway. The east side has short intermittent sections of sidewalk, primarily on the south portion of the road and there are several marked crosswalks at intersections. There are double yellow center lines along the length of this roadway, but no edge lines. The roadway is about 30 feet from curb-to-curb with several intersecting residential driveways and roadways. Park Avenue is the through road except at the intersection with 3rd Avenue which is an all-way stop. On-street parking was not observed along Park Avenue. Park Avenue has some minor horizontal curves and a relatively flat grade over the length of the roadway. Land use is primarily suburban residential with a large park on the east side of the road near 3rd Avenue and some commercial use near the intersection with Second Avenue. See Figure 6 for a representative picture of Park Avenue.



Figure 6: Park Avenue in Collegeville Borough

Traffic volume information for Park Avenue is available through the PennDOT Traffic Information Repository (TIRe). This data indicates an average daily traffic (ADT) of 4,711 vehicles per day (vpd). However, there seemed to be an anomaly in the data utilized for one year. Removing that data point, the ADT was 5,558 vpd with 4% trucks. Note that

this data was all pre-COVID conditions. This suggested that Park Avenue is operating as a collector road.

Speed data was available from a traffic study conducted in 2002 that indicated an 85th percentile speed of 38 MPH. However, this data is almost 20 years old and more recent data should be collected as part of a traffic calming study.

Crash data for a five-year period starting from January 1, 2015 through December 31, 2019 was obtained from PennDOT's online Pennsylvania Crash Information Tool (PCIT). This data indicates that there were eight (8) reportable crashes during this timeframe in the area (not including the intersections with East Main Street and 2nd Avenue). See Figure 7.

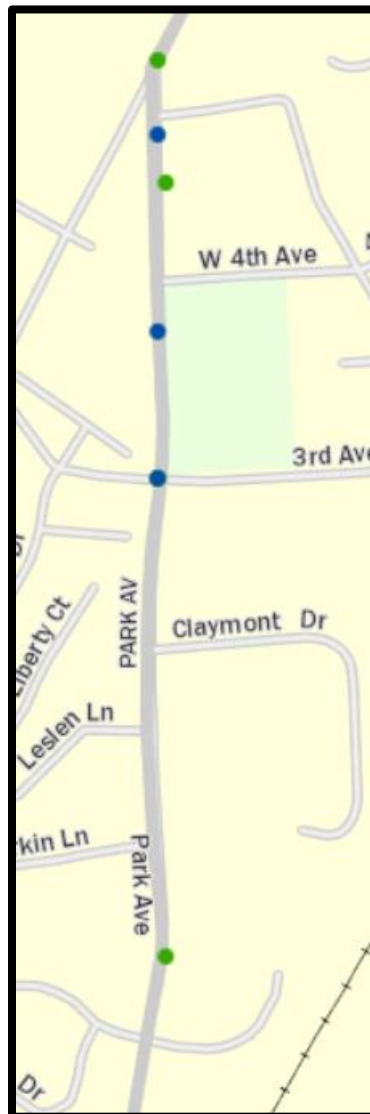


Figure 7: Park Avenue Crashes

Significant findings from the PennDOT crash data included:

- One (1), possibly two (2) of the 8 reportable crashes were speed related.
- Four (4) of the 8 reportable crashes occurred at intersections.
 - Two (2) occurred at the intersection of 3rd Avenue, one of which involved running a stop sign.
 - One (1) occurred at the intersection of 5th Avenue that involved speeding through the curve at this location.
 - One (1) occurred at the intersection of Clayhor Avenue due to an improper turning movement.
- Two (2) of the four (4) midblock crashes involved distracted drivers sideswiping another driver.
- Three (3) of the eight (8) crashes resulted in possible or suspected injury.
- Only one (2) of the eight (8) crashes occurred south of 3rd Avenue.

SUGGESTIONS FOR PARK AVENUE

Traditional Solutions

As the Borough considers a traffic calming policy and devices, they should continue with their traditional, lower cost solutions. These solutions include continuing to enforce the speed limit, public outreach/ education, enforcement, and the use of appropriate signs/ pavement markings including the speed awareness device. As you know, continued use of their radar speed alert signs or portable speed trailers that display the speed of vehicles as they pass by are an effective, albeit temporary, method for reducing speeds. These are particularly effective when combined with a speed enforcement detail.

Another consideration would be the installation of edge lines along the length of Park Avenue. These can narrow lane widths to about 10' and create the psycho-perceptual advantage of using narrow lanes to slow speeds. An alternative may be to consider implementing bike lanes along this roadway.

Traffic Calming Suggestions

As indicated in previous sections, LTAP recommends the Borough develop a traffic calming policy before implementing any traffic calming concepts. Further, the Borough should follow the policy and conduct appropriate studies before installing any traffic calming devices. The policy and the studies are critical to understand the various benefits and impacts of traffic calming as well as minimizing the Borough's liability. As noted above, many traffic calming concepts can be implemented on a temporary, trial basis. This will allow the Borough, residents, and emergency services all to determine the actual benefits and impacts of the traffic calming.

The other benefit of a traffic calming policy is to not overuse traffic calming devices where they are not appropriate or not warranted. Unwarranted traffic calming devices, just like unwarranted traffic control devices, tend to create more issues than solve them.

Speed Cushions

Some devices that could work on Park Avenue are speed tables or speed cushions/speed pillows. For a full description of each device, refer to Pub 383. Speed cushions are either speed humps or speed tables that include wheel cutouts to allow large vehicles to pass unaffected while reducing passenger car speeds. They can be offset to allow unimpeded passage by emergency vehicles and are typically used on key emergency response routes. The City of Philadelphia has a very successful speed cushion program. Refer to Figures 8 and 9.

Speed cushions should be used in series, from 250 to 600 feet apart. On Park Avenue, you will likely need at least three (3) sets of speed cushions along this section of the corridor to calm traffic. Figure 10 shows a series of five (5) speed cushions spaced about 250 to 350 feet apart with the first about 250' from the intersection with 3rd Avenue. The intersections, driveways, drainage, and other factors should be considered in the final design and placement of the speed cushions. As with the other concepts, there are temporary speed humps that can be tried on a trial basis. Keep in mind, these are only concepts – the Borough and their engineer will need to develop final layout options.



Figure 8: Speed Cushion Example (from NATCO)



**Figure 9: Speed Cushion Example
(from Bill Kenny, Northeast (Philadelphia) Times)**

While we focused on the segment of Park Avenue south of 3rd Avenue, the segment from 3rd Avenue to 5th Avenue may also be a candidate for speed cushions, especially considering the municipal park on the east side of the roadway. Speed data and pedestrian volumes may help determine applicability here.

There are other options to consider along this roadway:

- Curb extensions at the intersection with 3rd Avenue (and/or others) to improve pedestrian safety and slow turning movements at this location.
- Rather than speed cushions, the Borough could consider speed tables/raised crosswalks at the already delineated crosswalks along Park Avenue at the uncontrolled approaches. While speed cushions would be preferable to emergency response vehicles, the raised crosswalks can provide additional conspicuity to the existing marked crosswalks.



Figure 10: “Lower” Park Avenue Speed Hump Concept

While speed cushions and tables do control speeds and reduce traffic volumes, one complaint that may arise is that residents that live on Park Avenue and the side roadways must travel over them every day and hear other vehicles travel over them every day. There are also maintenance considerations as well as impacts on emergency vehicle response times and parking.

Mini-Roundabout

The Borough may also want to consider a mini-roundabout at the Park Avenue intersections with Clayhor Avenue and/or 3rd Avenue. While a neighborhood traffic circle may provide some horizontal deflection at these intersections, traffic volume may not make this a feasible option. Similarly, a full roundabout may be too expensive considering the right-of-way that may be needed. However, a mini-roundabout might be more practical (see attached sheet and Section 6.6 in NCHRP 672 (<https://nacto.org/docs/usdg/nchrprpt672.pdf>)). While volumes are not large coming off of most of the side streets, a mini-roundabout may serve as traffic calming measure, particular if combined with other measures like speed cushions elsewhere along the roadway. Mini-roundabouts would not be my first choice along this roadway but may be something for the Borough and their engineer to consider. Refer to Figure 11 for an example of a mini-roundabout.



Figure 11: Mini-roundabout Example

CLAYHOR AVENUE

Clayhor Avenue runs from the stop-controlled intersection with Park Avenue to the stop-controlled intersection with S. Trappe Road (SR 113) in Trappe Borough. Our visit focused on the portion of Clayhor Avenue that runs from Park Avenue to Locust Street where Clayhor is the through road. This segment is 0.80 miles long according to PennDOT's Type 5 Map. It is a paved two-way, two-lane Borough road that is currently posted at 25 MPH. Clayhor Avenue has curbing on both sides and continuous sidewalk installed as follows:

- the north side of the roadway from Park Avenue to R. Glad Way,
- both sides of the roadway from R. Glad Way to Colonial Avenue,
- the south side of the roadway from Colonial Avenue to the reverse horizontal curve,
- none through the reverse horizontal curve, and
- the south side from the end of the horizontal curve to Locust Street.

Clayhor Avenue has no center lines, edge lines, or marked crosswalks. The roadway is about 30 feet from curb-to-curb with several intersecting residential driveways and roadways. On-street parking was not observed along Park Avenue, and in some places was prohibited. This segment had some minor horizontal curves and a 3%-5% grade from R. Glad Way to Stratford Avenue. Land use is suburban residential. See Figure 12 for a representative picture of Clayhor Avenue.



Figure 12: Clayhor Avenue in Collegeville Borough

Traffic volume information for Clayhor Avenue was available through TIRe. This data indicated an ADT 1,896 vpd. However, there seemed to be an anomaly in the data utilized for one year and it also included data from July 2020 (COVID conditions). Removing these data points, the ADT was 3,149 vpd with 3% trucks which seems more realistic given the Borough's concerns. This indicates that Clayhor Avenue is operating as a collector road.

Speed data was available from a study conducted in 2002 that indicated an 85th percentile speed of 40 MPH. However, this data is almost 20 years old and more recent data should be collected as part of a traffic calming study.

Crash data for a five-year period starting from January 1, 2015 through December 31, 2019 was obtained from PennDOT's online Pennsylvania Crash Information Tool (PCIT). This data indicates that there were five (5) reportable crashes during this timeframe in the area. See Figure 13.



Figure 13: Clayhor Avenue Crashes

Significant findings from the PennDOT crash data included:

- None of the five (5) reportable crashes indicated that speed was a factor.
- Two (2) of the five (5) reportable crashes occurred at intersections.
 - One (1) occurred at the intersection of R. Glad Way that involved running the Stop sign.
 - One (1) occurred at the intersection of Clayhor Avenue due to an improper turning movement.
- The three (3) midblock crashes were related to distracted drivers running off the road. In two (2) cases, they hit utility poles. In one (1), the driver was DUI and hit shrubbery on the horizontal curve.
- None of the reportable crashes resulted in possible or suspected injury.

SUGGESTIONS FOR CLAYHOR AVENUE

Traditional Solutions

While crash data does not highlight a speed-related crash problem, the speed data does indicate an 85th percentile speed 15 MPH above the posted speed limit. Note that more recent speed data should be collected as part of a traffic calming study. Similar to Park Avenue, as the Borough considers a traffic calming policy and devices, they should continue with their traditional, lower cost solutions. These solutions include continuing to enforce the speed limit, public outreach/ education, enforcement, and the use of appropriate signs/ pavement markings.

Another consideration would be the installation of pavement markings along the length of Clayhor Avenue. LTAP recommends double yellow center lines and edge lines. Even

though edge lines are not needed due to the curbing in place, center and edge lines can narrow lane widths to about 10' and create the psycho-perceptual advantage of using narrow lanes to slow speeds. An alternative may be to consider implementing bike lanes or delineating parking along this roadway.

Traffic Calming Suggestions

As indicated in previous sections, LTAP recommends the Borough develop a traffic calming policy before implementing any traffic calming concepts. Some devices that could work on Clayhor Avenue are speed cushions/speed pillows, curb extensions, and mini-roundabouts. For a full description of each device, refer to Pub 383.

Much like on Park Avenue, if speed cushions are considered, they should be used in a series from 250 to 600 feet apart and you will need at least three (3) sets to calm traffic. One concern at this location may be the ~5% grade from Avon Avenue to Stratford Avenue. This may be contributing to speeding concerns traveling east on Clayhor and also may raise concern with the implementation of vertical measures. The intersections, driveways, drainage, and other factors should be considered in the final design and placement of the speed cushions. As with the other concepts, there are temporary speed humps that can be tried on a trial basis. Keep in mind, these are only concepts – the Borough and their engineer will need to develop final layout options.

Curb extensions at the intersections with R. Glad Way, Avon Avenue, Colonial Avenue and Stratford Avenue could also be utilized with or without the speed cushions. The curb extensions would not only decrease pedestrian crossing distance but may also be used to delineate the start and end of on-street parking if needed. The combination of horizontal and vertical measures could be successful at calming traffic in the segment.

Mini-roundabouts could also be considered at each of these intersections but may be difficult to implement with the grades and existing drainage facilities. Refer to Figure 14 for a concept drawing. Note that these devices may be too closely spaced together – it is just a concept. The circles represent a mini-roundabout or curb extensions on all appropriate corners while the lines represent speed cushions.



Figure 14: “Lower” Clayhor Avenue Traffic Calming Concept

EAST 9th AVENUE

East 9th Avenue runs from the signalized intersection with Main Street (SR 4031) to the stop-controlled intersection with Gravel Pike (SR 0029). This segment is 0.77 miles long according to PennDOT’s Type 5 Map. It is a paved two-way, two-lane Borough road that is currently posted at 25 MPH. The first 650 feet of roadway from SR 0029 has no pavement markings, but curbing on both sides and continuous sidewalk on the south side of the road. This area is suburban residential with several intersecting residential driveways and roadways. The grade on E. 9th Avenue is about 8% at this location. For the next 600 feet, the roadway flattens and narrows slightly, and suburban residential land use continues. There are no sidewalks along this segment, but centerline pavement markings are installed. The remaining portion of the roadway is rural residential with homes and Ursinus College on the east side and homes and a park on the west side. There is significant vertical and horizontal curvature along this roadway. Center lines have been installed but edge lines are intermittent. See Figure 15 for a representative picture of E. 9th Avenue.



Figure 15: E. 9th Avenue in Collegeville Borough

Traffic volume information for E. 9th Avenue was not available through TIRe. Data collected in 2002 indicated an ATD of 1,561 vpd and an 85th percentile speed of 40 MPH. However, this data is almost 20 years old and more recent data should be collected as part of a traffic calming study.

Crash data for a five-year period starting from January 1, 2015 through December 31, 2019 was obtained from PennDOT's online Pennsylvania Crash Information Tool (PCIT). This data indicates that there were four (4) reportable crashes during this timeframe in the area not including the intersections with SR 0029 and Main Street (SR 4031). See Figure 16.

Significant findings from the PennDOT crash data included:

- All of the reportable crashes occurred when drivers failed to negotiate a curve and ran off the road.
- In two (2) of the crashes, the drivers were DUI.
- Speed was a specific factor in one (1) of the crashes, but likely was involved in all four (4) crashes considering drivers failed to negotiate curves.
- Two (2) of the four (4) reportable crashes resulted in possible or suspected injury.

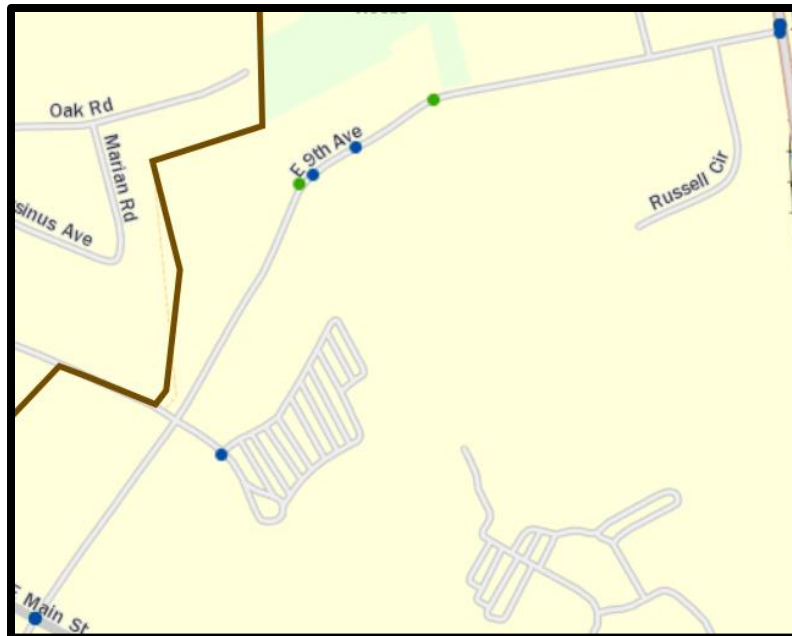


Figure 16: East 9th Avenue Crashes

SUGGESTIONS FOR EAST 9th AVENUE

Traditional Solutions

Crash data suggests a speed-related crash problem, and the speed data does indicate an 85th percentile speed 15 MPH above the posted speed limit. Similar to Park Avenue, as the Borough considers a traffic calming policy and devices, they should continue with their traditional, lower cost solutions. These solutions include continuing to enforce the speed limit, public outreach/ education, enforcement, and the use of appropriate signs/ pavement markings including the retroreflective strips underneath the Speed Limit signs.

The Borough should also consider installing edge lines along the length of E. 9th Avenue.

In addition, LTAP recommends a curve study be conducted on E. 9th Avenue. This study would help address the curve-related crashes along this segment of roadway as well as determine appropriate advanced warning signs and delineation including advisory speeds for these curves. LTAP would be happy to assist with this study upon request.

Traffic Calming Suggestions

As indicated in previous sections, LTAP recommends the Borough should develop a traffic calming policy before implementing any traffic calming concepts. While not traditionally placed on roadways without curbing, speed cushions could work on E. 9th Avenue. Non-traditional pavement markings are another option to consider. For a full description of each device, refer to Pub 383.

Much like on Park Avenue and Clayhor Avenue, if speed cushions are considered, they should be used in a series from 250 to 600 feet apart. LTAP does not recommend their use in the segment of roadway where the horizontal and vertical curves have contributed to crashes. They could be used in advance of this area in both directions if the traffic calming study determines it to be appropriate. In addition to the roadway geometry, intersections, driveways, drainage, and other factors should be considered in the final design and placement of the speed cushions. Keep in mind, these are only concepts – the Borough and their engineer will need to develop final layout options. Refer to Figure 17 for a concept drawing.

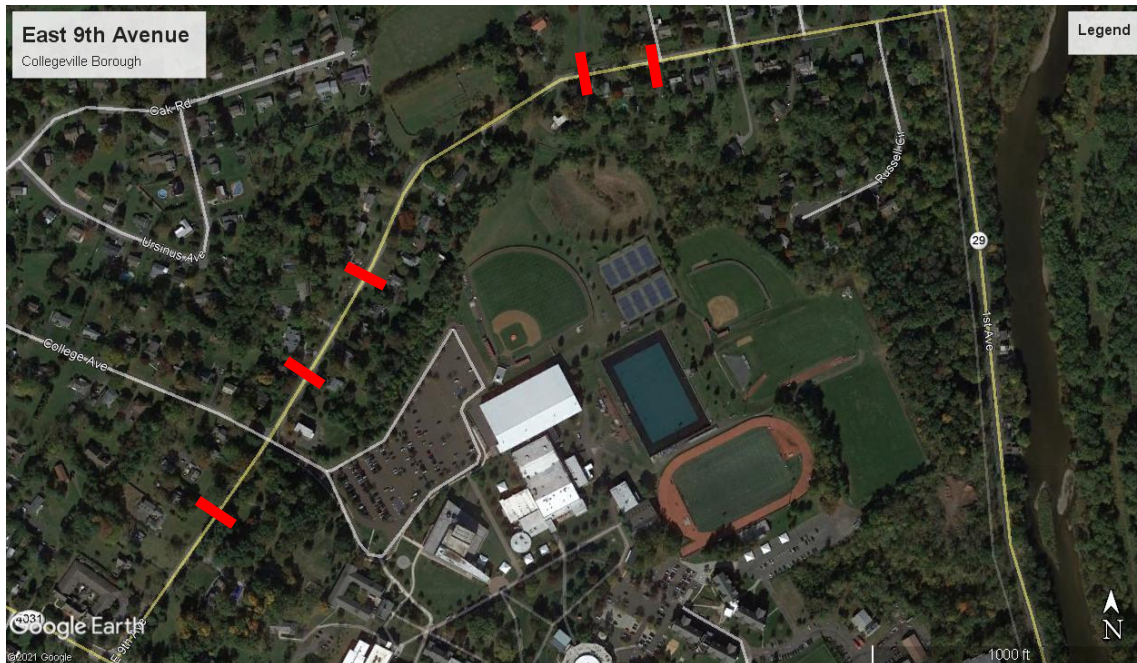


Figure 17: East 9th Avenue Traffic Calming Concept

Non-Traditional Pavement Markings

The Borough could consider installing optical speed bars, also known as speed reduction pavement markings, in advance of the horizontal curves in both directions. These are transverse markings that are placed on the roadway within a lane (along both edges of the lane) in a pattern of progressively reduced spacing to give drivers the impression that their speed is increasing. These markings are typically placed in advance of an unexpectedly severe horizontal or vertical curve or other roadway feature where drivers need to decelerate prior to reaching the feature. Additional information is included in Section 3B.22 of the MUTCD. See Figure 18.



Figure 18: Optical Speed Bars Example

While the results of the optical bars on reducing speed is muted, the positive impact of edge line and/or center line rumble strips is well documented in Pennsylvania. If the Borough is considering edge line and/or center line rumble strips, they should work with an engineer to review PennDOT criteria/guidelines for their potential use on E. 9th Avenue. The significant disadvantage to edge line and centerline rumble strips is the noise that they may generate in a residential neighborhood.

As an alternative to milled-in center line or edge line rumble strips, the Borough could also try Thermoplastic Transverse Rumble Strip Pavement Markings. These are double thick thermoplastic transverse pavement markings that could bring attention to and slow traffic travelling down in targeted areas. Refer to page 63 of PennDOT Publication 383, *Pennsylvania's Traffic Calming Handbook*. Transverse pavement markings can be implemented quickly and effectively and are not as costly or noisy as milled rumble strips. Refer to Figure 19.

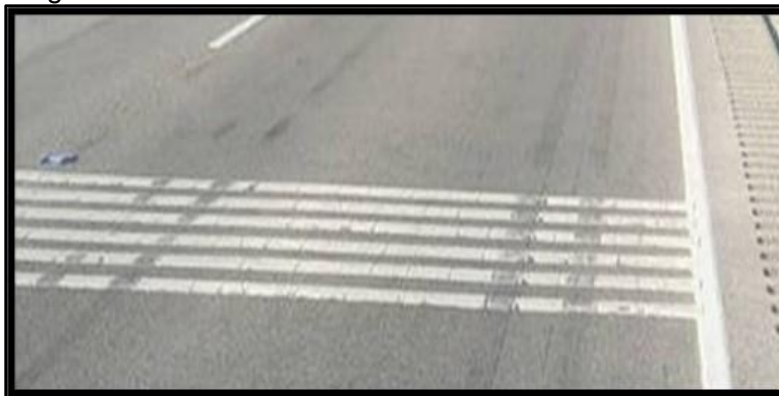


Figure 19: Thermoplastic Transverse Rumble Strip Pavement Markings

SUMMARY AND NEXT STEPS

Based on a field view of the roadways, a review of traffic and crash data, and a review of the applicable standards/guidelines, Park Avenue, Clayhor Avenue, and E. 9th Avenue are candidates for traffic calming measures including speed cushions, curb extensions, mini-roundabouts, and non-traditional pavement markings. However, LTAP recommends that the Borough establish a traffic calming policy first. From there, updated data can be collected, a detailed traffic calming study can be completed, and devices can possibly be implemented. Work with your Borough engineer on policy development, implementation of temporary measures, and possible designs and layout options for traffic calming measures.